Plant Science Pamphlet 20
Annual Progress Report

Progress Report 2004

Central Crops and Soils Research Station
Highmore, South Dakota

SDSU

South Dakota State University • Plant Science Department • Brookings, South Dakota 57007

Plant Science Pamphlet 20
Annual Progress Report

Progress Report 2004

Central Crops and Soils Research Station
Highmore, South Dakota

South Dakota State University · Plant Science Department · Brookings, South Dakota 57007

SDSU

AES105 Highmore Progress Report: 168 copies at $1.98, printed by Plant Science Department, February 2005.

• *Greetings* •

Dale Gallenberg
Head, Plant Science Department, SDSU

Greetings! On behalf of the Plant Science Department at South Dakota State University, I want to thank you for taking the time to read through this report summarizing the research and Extension projects during 2004 at the Central Crops and Soils Research Station at Highmore. We hope the data is useful to you, and helps answer some of the questions you have regarding crop production in central South Dakota.

We welcome your comments and input into our activities at the Station, and hope you will take the time to visit with us about what we are doing and what additional projects we might consider.

I want to thank Mike Volek, senior agricultural research technician, for his continued excellent work at the Station and Robin Bortnem, research associate, for overall management of projects and activities. Thanks are also extended to each of the project leaders and support staff for their efforts in developing and conducting research projects that are meant to address local issues and answer questions for producers.

Once again, thanks to each of you for taking the time to be part of our efforts at Higlunore. Let us know how we're doing, and where we should be headed in the future.

• *Welcome* •

Robin Bortnem
Manager, Central Crops and Soils Research Station

The weather was nice and the station looked great for the 2004 Field Day on June 30. The 3:00 pm tour featured weed control in winter wheat, spring wheat, oats, field peas, chickpeas, alfalfa, flax, safflower, and corn and was conducted by Leon Wrage (SDSU Extension agronomist, weeds) and Darrell Deneke (IPM coordinator). The tour addressed herbicide comparisons, wild buckwheat control, wild oat treatments, seedbank buildup, volunteer sunflower control, and alfalfa burndown. The weed project had established over 600 plots with 220 weed control treatment comparisons for the tour.

This was followed by a meal and the traditional twilight tour. The twilight tour included winter wheat by Amir Ibrahim (winter wheat bBreeding, SDSU), sunflower insect pests research by Kathy Grady (sunflower breeder/Extension oil seeds, SDSU), spring-seeded small grain varieties by Bob Hall (Extension agronomist, SDSU), soil fertility with Jim Gerwing (Extension soils, SDSU), annual warm season forages by Peter Jeranyama (Extension forages, SDSU), and an update on the network weather stations by Dennis Todey (Extension/state climatologist, SDSU).

A significant amount of time and hard work went into making our tour a success. I'd like to take this time to thank all that were involved, Mike Volek and crew, several Plant Science personnel, and all the speakers, Dixie Volek and daughters Shandra and Sherise who prepared the desserts and helped serve the meal, and Pioneer Garage of Highmore who provided the pickups and trailers used for the tour.

The research conducted each year and included in this report involves long hours by staff from many disciplines at SDSU and the Highmore Research Farm. Their efforts in contributing to this publication each year are greatly appreciated. Support and input from area producers, ranchers, advisory board members and county Extension educators is also greatly appreciated.

A special thanks to Nancy Kleinjan for her assistance in preparing this report.

• 2004 Central Substation Advisory Board •

Name	Position	Address	Phone	County
Ken Wonnenberg	Secretary, Extension	Gettysburg	765-9414	Potter
Terence Hall	Extension	Onida	258-2334	Sully
Mark Major	Extension	Wessington Springs	539-9471	Jerauld
Karin Schiley	Extension	Highmore	852-2515	Hyde
Todd Weinmann	Extension	Huron	353-8436	Beadle
Sarah Runyan	NRCS	Highmore	852-2221	Hyde
Gregg Yapp	NRCS	Huron	352-1238	Beadle
Slade Roseland		Faulkton	598-6742	Faulk
Randy Hague	Chairman	Highmore	852-2874	Hyde
Lyle Stewart		Pierre	224-5682	Hughes
Donald Hinckley		Gettysburg	765-9389	Potter
Dennis Beckman		Wessington Springs	539-9613	Jerauld
Dave Nelson		Miller	853-3845	Hand
Mike Volek	Station Superintendent	Highmore	852-2829	Hyde
Chris Ohnstad	Extension Supervisor	Brookings	688-5132	SDSU
Dale Gallenberg	Plant Science Department head	Brookings	688-5123	SDSU
Robin Bortnem	Central Research manager	Brookings	688-4958	SDSU
Kevin Kephart	Experiment Station director	Brookings	688-4149	SDSU

• Contents •

Growing season temperature and precipitation data for the Highmore research station during 2004.

	Temperature (°F) Maximum	Minimum†	Average	No. days Max > 90°	Precipitation (inches)
April	64	34		0	0.00
May	72	44		1	4.77
June	72	55		0	4.15
July	84	58		8	2.92
August	79	54		4	2.55
September	77	48		8	4.20

† Minimum temperature measurements were not obtained for several days in June, August, and September due to weather station malfunctions. Minimum temperatures listed for those months are the average of available data.

Field Evaluation of Woody Plant Materials, Highmore, South Dakota

Dwight Tober
Plant Materials Specialist, USDA/NRCS, Bismarck, N.D.

Objectives

1. Assemble and evaluate the adaptation and performance of selected woody plant material for field and farmstead windbreaks, wildlife habitat, and stream bank and lakeshore plantings in the Northern Great Plains.
2. Select and cooperatively release superior woody conservation plants for increase by commercial nurseries.

Activities in 2004

A total of approximately 140 accessions of 87 different species are currently being evaluated.

New entries were planted on May 17, 2004, and included black currant (*Ribes americanum*), Missouri gooseberry (*Ribes missouriense*), aspen (*Populus tremuloides*), Amur linden (*Tilia amurensis*), and black cherry (*Prunus serotina*). These entries were planted between tree stumps of several accessions of apricot which were removed in 2002. The planting of new entries will be limited in the future because of shading and lack of room. Significant information can still be documented from existing entries and data collection will continue on a scheduled annual basis.

The first entries were planted at the Highmore site on April 11, 1978. Data is summarized annually and documented in the Annual Technical Report. Anyone who desires a copy of the latest technical report from Highmore should contact me at (701)530-2075 or at Dwight.Tober@nd.usda.gov. The report is about 40 pages in length. We do anticipate completing a 25-year report this winter with complete data summary information inclusive to all species tested at this site.

Weed control and maintenance have been consistently good. A major renovation effort in 2000 included removal of broken branches and limbs resulting from snow damage, removal and pruning of natural dieback of some species (primarily shrubs), and cutting and removal of contaminant species (primarily Siberian elm and mulberry). All of the apricot (8 entries) and some entries of crabapple, poplar, Russian olive, and other species have been removed at various times by staff at the station.

Selected trees and shrubs were evaluated on August 27, 2004. Measurements and notes were taken on crown spread and plant height, disease and insect damage, drought and cold tolerance, fruit production, survival, vigor, and snow and animal damage. Most of the mature entries continued to perform well; species noted as doing exceptionally well included Freedom honeysuckle, pygmy caragana, juneberry, chokeberry, nannyberry, Scot's pine (variety Mongolica), and Arnolds Red honeysuckle.

Numerous species are in an annual state of decline because of disease and natural die-back as they approach the end of their life span. The new entries planted this spring did not survive well and appeared to have sustained some herbicide damage.

Data collected from this site will be used to support the formal release of two new shrubs scheduled for this winter: ND-3209 sandbar willow, which was planted in 1990, and 998041 false indigo, which was planted in 1987. They both had 100% survival and superior performance for at least the first 5 years, even though both species are subject to occasional winter dieback.

Formal releases with supporting documentation from the Highmore site

'Cardan' green ash (1979)
'Oahe' hackberry (1982)
'Sakakawea' silver buffaloberry (1984)
'Scarlet' Mongolian cherry (1984)
'Centennial' cotoneaster (1987)
'McDermand' Ussurian pear (1990)
'Homestead' Arnold hawthorn (1993)
'CanAm' hybrid poplar (1995)
'Regal' Russian almond (1997)
'Legacy' late lilac (1999)

Summary of accomplishments

Selected accessions/cultivars that have performed well at the Highmore site and show promise for additional testing

and/or promotion for conservation use include the following:

'Cardan' green ash
'Centennial' cotoneaster
'Sakakawea' silver buffaloberry
'Indigo' silky dogwood
ND-1134 hybrid plum
ND-3902 sandbar willow
ND-1879 honeylocust
'Legacy' late lilac
9058862 tamarack
ND-170 cotoneaster
'Bighorn' skunkbush sumac
14272 hybrid poplar
9069081 littleleaf linden
9063130 river birch
9016318 Siberian elm
Arnold's Red honeysuckle
9057409 American hazel
ponderosa pine (ND-1763, 9067413)
Scot's pine (9063156, 9063154)
9063148 corktree
'Oahe' hackberry
'Scarlet' Mongolian cherry
'McDermand' Ussurian pear
'Regal' Russian almond
ND-21 nannyberry
9047238 sea buckthorn
9008041 false indigo
ND-1863 honeylocust
'Meadowlark' forsythia
'Midwest' Manchurian crabapple
323957 chokeberry
ND-2103 highbush cranberry
hybrid poplar 9069086 (Theves)
9047228 pygmy caragana
ND-46 Timm's juneberry
ND-3744 Korean barberry
Siberian larch (SL-383, ND-1765)
9057411 lodgepole pine
9057410 hackberry
9063116 black ash

Data from this planting has been used to document the cooperative release of the cultivars listed on the previous page. These cultivars are generally available from local conservation nurseries and are used in conservation plantings throughout the Northern Great Plains. Several more releases are anticipated in the near future.

Information gathered concerning plant performance assists cooperating nurserymen and plant researchers in determining the range of adaptation of many other accessions/cultivars also included in the test planting.

This research was sponsored and financial support was provided by the SDSU Agricultural Experiment Station, the SDSU Plant Science Department, the Hyde County Soil Conservation District, and the USDA Natural Resources Conservation Service.

Optimal Management of Drought-Tolerant Legumes and Warm-Season Annual Grasses

Peter Jeranyama and **Vance Owens**
South Dakota State University

Cool-season perennial grasses make up the bulk of forage consumed by livestock in the Northern Great Plains; however, annual species are being used more frequently as emergency forage sources.

In some operations, annuals fit better into crop rotations than perennial forages. Summer annual forages, since they are quick to establish, can also supply emergency forage under conditions of drought or after a winter where there has been considerable mortality of perennial species such as alfalfa.

Many acres of perennial forage have been lost in recent years due to the drought in north-central and western South Dakota. Producers are looking for viable annual forage alternatives to replenish forage supplies for livestock operations. This trial is evaluating the potential to mix annual warm-season grasses and annual legumes as emergency forages. The objective of the study was to evaluate forage yield and quality of annual warm-season grass and legume species either alone or in two-way legume/grass mixtures.

Materials and methods

Pigeonpea, cowpea, pearl millet, and foxtail millet were planted alone and in all possible two-way legume/grass mixtures (total of eight) in plots 6 x 20 ft at the Central Crops and Soil Research Station, Highmore. Ten rows with 6-inch spacings were planted with a five-row plot planter. Plots were fertilized with 100 lb/a of 18-46-0 at planting and no additional fertilizer was used.

Seeding rates were as follows: pigeonpea at 36 lb/a in pure seeding and 18 lb/a in mixtures, cowpea at 48 lb/a in pure seeding and 24 lb/a in mixtures, pearl millet and golden foxtail at 20 lb/a and their associated mixtures were seeded at 10 lb/a. Experimental design consisted of an 8 x 2 factorial replicated four times in a randomized complete block becoming repeated measures with respect to harvest time.

Plots were harvested with hand clippers at two stages of maturity (boot- to early heading and soft- to hard-dough) to evaluate yield and quality based on maturity. Sub-samples were taken from each plot for analyses of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and in vitro dry matter digestibility (IVDMD). Botanical composition was assessed by hand-separating the grass from legumes and or weeds in each mixture. Each component was dried to express yield on dry matter basis. The same samples were recomposited for forage quality analyses.

Results

Table 1 shows the forage yield on dry matter basis obtained at two harvest dates, and Table 2 shows the mixtures' yield and their botanical compositions.

This research was sponsored by the CES and AES.

Table 1. Forage yield of several annual warm-season forages alone or in mixtures at Highmore, 2004.

Forage	*August 25*	*October 6*
	----ton/acre----	
Cowpea	1.0	1.2
Pigeonpea	0.8	1.9
Golden foxtail millet	2.5	2.4
Pearl millet	2.5	3.0
Golden foxtail millet + Cowpea	2.8	2.9
Golden foxtail millet + Pigeonpea	2.7	2.1
Pearl millet + Cowpea	1.3	2.9
Pearl millet + Pigeonpea	2.1	3.2
LSD5%	1.0	1.2
CV, %	34	33

Table 2. Forage yield of mixtures of annual grass and several legumes, and the botanical composition of the yield in August, 2004 at Highmore.

Forage	Yield ton/acre	Grass	Legume	Others
		%		
Golden foxtail millet + Cowpea	2.8	99	1	0
Golden foxtail millet + Pigeonpea	2.7	97	1	2
Pearl millet + Cowpea	1.3	90	3	7
Pearl millet + Pigeonpea	2.1	99	1	0
LSD 5%	1.0	NS	NS	NS
CV, %	34			

Winter Wheat Breeding and Genetics

Amir Ibrahim, Steve Kalsbeck, and Rich Little
South Dakota State University

The Winter Wheat Breeding and Genetics Program utilizes the Central Research Station at Highmore primarily for early-generation testing and evaluation of advanced-generation lines. The breeding program also conducts field trials at several other sites throughout South Dakota. Central Research Station trials conducted in 2004 by the winter wheat program included:

1. The CPT Variety Trial, under the overall coordination of Bob Hall. The trial included 30 entries, consisting of 13 released varieties (including new releases from other states), 16 advanced experimental lines from our program, and one experimental line from Nebraska. This trial was also grown at 13 other sites in South Dakota. Prior to cultivar release, promising elite lines must be grown in the CPT Variety Trial for 3 years to accurately measure potential performance across a range of environmental conditions.

2. The South Dakota Advanced Yield Trial (AYT), with both hard red and hard white lines. The AYT nursery included 45 entries, consisting of 39 advanced experimental lines and 6 checks. Eight of the experimental lines have the white kernel color. The AYT nurseries were also grown at six other sites in South Dakota and one each in North Dakota and Nebraska . Each year, three to six superior experimental lines are selected from these nurseries and advanced to the CPT Variety Trial and the Northern Regional Testing Program.

3. Early-generation F_2-bulk populations, consisting of 293 different cross combinations. Undesirable F_2 populations are eliminated from the program based largely on visual observations, pedigree and parental characteristics, and bulk yield. Desirable F_2 populations are advanced to the F_3 bulk nursery for further evaluation prior to head selection the following year.

Trial conditions

The nurseries at Highmore were planted 0.75 inches deep into fallow soil with excellent moisture conditions on September 16, 2003. Plots were sprayed in late April 2004 with 5 quarts Ramrod per acre and in early May 2004 with 1.5 pints Bronate per acre. Yield and test weight data for Highmore and other CPT locations are presented in Table 1.

Acknowledgements

Each year, 600-800 new cross combinations are made and 600-800 new experimental lines are developed by the winter wheat breeding program. In addition to the excellent support of our wheat pathology programs (small grains pathology and virology), the solid and consistent financial support from the South Dakota Wheat Commission and the South Dakota Crop Improvement Association are vitally important to ensuring continued availability of improved winter wheat varieties for producers in South Dakota.

Oat Research

Lon Hall
South Dakota State University

Yield, yield stability, and test weight are the most important characteristics associated with the identification and eventual release of oat varieties. There are, however, several additional factors that contribute to the expression of these primary characteristics.

Resistance to lodging, Barley Yellow Dwarf Virus (BYDV), stem rust, and crown rust all affect yield potential and test weight. Other traits that are considered prior to varietal release include hull, protein, and oil percentages, as well as maturity, hull color, plant height, and whether the grain is hulled or hulless.

Consumers desire different characteristics for specific needs. Millers generally want oats with high protein, high beta-glucan content, and low oil. Livestock producers prefer tall varieties with high levels of protein and oil. The racehorse industry demands a high quality, white-hulled or hulless oat variety. Tall varieties, such as Loyal, are popular forage oats.

The main emphasis of the oat breeding programs is development of hulled varieties. Market demand for milling and feed oats isn't affected by hull color; however, the racehorse industry desires white-hulled varieties. Therefore, emphasis is placed on development of white-hulled varieties with desirable traits for milling and/or feed. Recently there has been interest in hulless oats for feed and other specialty uses; therefore, we have increased our effort to develop a high-oil hulless oat.

Plant breeding is a long drawn out process. The bulk breeding method takes, on average, at least 10 years from the initial cross to variety release. This process may be shortened by 2 to 3 years by using a modified single seed descent method, which involves two extra generations in the greenhouse and a winter increase in New Zealand. Each year there are approximately 37,000 non-segregating plants and head rows observed within this program. In 2004, there were 3,862 unique non-segregating lines yield tested. There were a total of 6,870 yield plots.

Data collected from regional nurseries provides valuable information for variety release and germplasm selection for crossing in our program. The Tri-State regional nursery is made up of 30 hulled lines and 6 checks. The 30 lines consist of 10 advanced lines each from Minnesota, North Dakota, and South Dakota. Advanced increase lines are entered in the Uniform Early Nursery, Uniform Midseason Nursery, Quaker Uniform Oat Nursery, and/or South Dakota Standard Variety Oat Trials (SVO). Hulless lines are tested in the Cooperative Naked Oat Trial and/or SVO.

SD000366-15 and SD000366-36 are sister lines that have been approved to increase for intent to release. If approved for variety release, one of these lines will be available to the producers for the 2006 growing season. They are white-hulled oat lines with a high test weight, good disease resistance, and yield potential. When averaged over 13 tests, SD000366-15 yielded 7.6 bushels more and had a 1.1 lb test weight advantage over Jerry. SD000366-36 yielded 14 bushels more and had .9 lb test weight advantage over Jerry. They are slightly taller and head 1 and 2 days later than Jerry, respectively.

Limited data shows both lines have adequate stem rust and lodging resistance. Field and buckthorn nursery evaluations indicate both lines have excellent crown rust resistance. Barley Yellow Dwarf resistance appears to be good; however, there was only one evaluation in 2003.

SD000366-15 and SD000366-36 will be evaluated next year in Crop Performance Testing and the Uniform Midseason Oat Nursery (UMO). UMO data is collected from 16 locations in the USA and Canada and is very useful for seed quality and disease evaluations. UMO disease data is collected in buckthorn nurseries, inoculated tests, and field infections. Yield data from the UMO is considered; however, emphasis is placed on Crop Performance Trials and breeder data.

Production research included a naked oat herbicide and fertilizer test at the Brookings location and a dormant seeding test at Brookings and Dakota Lakes Research Stations. Rye varieties and lines are also tested in Brookings.

This research is funded in part by annual grants from the Quaker Oats Company and by the SDSU Agricultural Experiment Station, Crop Improvement Association, and the SDSU Plant Science Department.

Resistance of Sunflower Germplasm to the Red Sunflower Seed Weevil, Highmore, 2004

Kathleen Grady
South Dakota State University
Larry Charlet and Jerry Miller
USDA-ARS, Northern Crop Science Lab, Fargo, N.D.

The red sunflower seed weevil, *Smicronyx fulvus* LeConte, is a serious pest of sunflower in North and South Dakota. Adult females lay eggs in immature seeds, the eggs hatch, and larvae consume a portion of the kernel, causing economic damage in the form of lost yield and oil content of oilseed sunflower and both yield and quality of confection sunflower.

The goal of this project is to identify sunflower germplasm with genetic resistance to the red sunflower seed weevil. Resistant germplasm, if identified, will be made available to seed companies for incorporation into hybrids.

This was the third year of a cooperative trial conducted by the USDA-ARS Sunflower Research Unit, Fargo, N.D., and the South Dakota Experiment Station. Sunflower germplasm tested were lines developed by the USDA-ARS through a recurrent selection breeding procedure, interspecific crosses, and accessions obtained from the North Central Plant Introduction Station, Ames, Iowa.

In 2002, 41 lines and 15 accessions were screened at Highmore. The treatments were replicated four times in a randomized block experiment. Up to four heads from each row (treatment) were threshed and a pooled sample of seed sent to the USDA-ARS, Northern Crop Science Laboratory, Fargo, N.D., for evaluation of seed damage. A random sample of 200 seeds from each plot was examined and the percentage of seeds damaged by larval feeding determined.

Red seed weevil infestation levels were high at Highmore in 2002, and seed damage levels ranged from 8% to 55%.

The 2003 trials at Highmore retested 20 lines and 4 accessions that showed low numbers of damaged seeds in the 2002 trials, plus 8 new accessions. Four replications were planted and five sunflower heads were harvested from each plot. Heads were threshed individually and seed shipped to the USDA-ARS sunflower insect laboratory, where they evaluated 100 seeds from each head for seed weevil damage. Seed damage ranged from 5% to 41%.

In 2004, 18 accessions and the check variety USDA Hybrid 894 were planted in single-row plots, four replications. Up to five heads were harvested and threshed from each row and a pooled seed sample sent to Fargo for damage evaluation. Results are pending.

The Highmore portion of this research was funded by the SDSU Agricultural Experiment Station and the SDSU Plant Science Department oilseed breeding project.

Table 1. Mean percentage of seed damaged by red sunflower seed weevil from sunflower lines and accessions evaluated at Highmore, S.D., in 2004.

Line or Accession	ID	% Damaged Seed 2002	2003	2004*
98 1854	USDA RSSW	13.1	11	--
98 1855	USDA RSSW	17	22	--
98 1859	USDA RSSW	22.8 + 5.2	10	--
98 1860	USDA RSSW	19.8 + 9.9	12	--
98 1864	USDA RSSW	21	11	--
98 1865	USDA RSSW	26.3 + 12.8	23	--
98 1867	USDA RSSW	18.8 + 0.8	12	--

Table 1, cont.

Line or Accession	ID	% Damaged Seed 2002	2003	2004*
981871	USDA RSSW	13.5	20	--
981873	USDA RSSW	22.0 + 8.1	12	--
981875	USOARSSW	24.2 + 14.9	14	--
98 1879-4	USDA RSSW	13.8 + 5.9	5	--
98 1881	USDA RSSW	12.6 + 3.6	13	--
981882	USDA RSSW	8.1 + 4.1	17	--
981883	USDA RSSW	23.8 + 5.3	25	--
981884	USDA RSSW	7.8 + 1.8	8	--
98 1885	USDA RSSW	9.3 + 1.8	17	--
981892	USDA RSSW	15.6 + 11.4	22	--
981893	USDA RSSW	22	18	--
98 1898	USDA RSSW	13.0 + 6.2	27	--
98 1868	USDA RSSW	36.8 + 3.1	15	--
TUB-346	TUB-346	--	27	--
TUB-1709-2	TUB-1709-2	--	32	--
RF-TUB-346	RF-TUB-346	--	30	--
GIG-1616-2	GIG-1616-2	--	35	--
PI 251465	NO. K1918	24.7 + 4 6	23	--
PI 486366	CAKSISKIJ 269	8.0 + 4.0	25	--
PI 294658	SMENA (SUS)	--	18	--
PI 431506	T 6651-1-2 (SUS)	42.3 + 20.9	21	--
HYB894	Hybrid 894(check)	29.8 + 13.8	26	*
Hlr 828-3		--	41	*
Str 1622-1		--	17	*
Str 1622-2		--	15	*
Ames 3269	PURPUREUS	18.2 + 1.3	13	*
Ames 3391		--	--	*
Ames 3454		--	--	*
PI 170385		--	--	*
PI 253776		--	--	*
PI 267665		--	--	*
PI 291403		--	--	*
Hybrid 894	Hybrid 894(check)	29.8 + 13.8	26	*
PI 386230		--	--	*
PI 431506	T 6651-1-2 (SUS)	42.3 + 20.9	21	*
PI 431513		--	--	*
PI 431542		--	--	*
PI 494859		--	--	*
PI 494861		--	--	*
PI 497939		--	--	*
PI 505651		--	--	*
Hybrid 894	Hybrid 894(check)	--	24	*

* Seed damage evaluations from 2004 are in process.

Weed Control

L. Wrage, D. Deneke, D. Vos, B. Rook
South Dakota State University

Experiment stations make it possible to evaluate experimental treatments and to demonstrate practices. The Highmore station is a strategic location for several weed control field trials. The location provides performance data and field tour training opportunities for producers and industry in central South Dakota.

2004 projects

This was the second year of expansion of crops included in the evaluation and demonstrations. Pulse crop work was expanded. Wild oat and wild buckwheat in wheat, kochia burndown, alfalfa establishment, and millet are recent additions. Corn, soybean, sunflower, safflower, oat, and grain sorghum evaluations were continued.

2004 season

Dry, cool weather slowed early crop and weed development. Crop development improved as the season progressed. Weed growth was somewhat variable in some cereal crop sites.

2004 reports

Fertilizer and Herbicide Carrier in Winter Wheat
Wild Buckwheat Control in Spring Wheat
Wild Oat Control in Spring Wheat
Volunteer Express Sunflower Control in Spring Wheat
No-Till Corn Demonstration
Soybean Herbicide Demonstration
Grain Sorghum Demonstration
Weed Control in Sunflowers
No-Till Sunflower Demonstration
Chickpea Demonstration
Field Pea Weed Control
Weed Control in Safflower
Flax Demonstration
Evaluation of Herbicides on Millet
Alfalfa Demonstration - New Seeding
Spring Alfalfa Burndown
Kochia Burndown

Acknowledgements

The cooperation and direct assistance of Mike Volek is acknowledged. Field equipment and management of the plot areas are important contributions to the project.

Program input and partial support for field programs is also acknowledged:

South Dakota Soybean Research and Promotion Council
South Dakota Corn Utilization Council
South Dakota Oilseed Council
National Canola Research Association
National Sunflower Association
Consortium for Alternative Crops
Crop Protection Industries

NOTE: Data reported in this publication are results from field tests that include experimental products, experimental uses, or experimental rates or combinations, or other unlabeled uses for herbicide products. Tradenames of products used are listed; there frequently are other brand products available in the market. Users are responsible for applying herbicide according to label directions. Refer to the appropriate weed control fact sheet available from county Extension offices for herbicide recommendations.

Table 1. Fertilizer and herbicide carrier in winter wheat.

RCB; 3 reps
Planting Date: 9/16/03
Variety: Wesley
POST: 5/20/04; wheat 4 lf, 12-14"
Wibw 3-6"
Soil: Clay loam; 2.5% OM; 6.2 pH

Precipitation:
POST: 1st week 1.95 inches
2nd week 0.42 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Wibw=Wild buckwheat

COMMENTS: Purpose is evaluate the effect of liquid nitrogen fertilizer on postemergence herbicide performance. Increasing fertilizer did not reduce wild buckwheat control and did not increase visual crop injury response.

Treatment	*Rate/A*	*Carrier*	*% VCRR 7/20/04*	*% Wibw 7/20/04*
Check	---	---	0	0
POSTEMERGENCE				
2,4-D ester	1 pt	20 gal water	0	23
2,4-D ester	1 pt	10 gal water/ 10 gal 28% N	0	20
2,4-D ester	1 pt	20 gal 28% N	3	10
Bronate Advanced	1.2 pt	20 gal water	0	85
Bronate Advanced	1.2 pt	10 gal water/ 10 gal 28% N	0	73
Bronate Advanced	1.2 pt	20 gal 28% N	0	72
Ally Extra+2,4-D ester+NIS	.3 oz+.5 pt+.25%	20 gal water	0	85
Ally Extra+2,4-D ester+NIS	.3 oz+.5 pt+.25%	10 gal water/ 10 gal 28% N	0	88
Ally Extra+2,4-D ester+NIS	.3 oz+.5 pt+.25%	20 gal 28% N	0	90
LSD (.05)			3	8

Table 2. Wild buckwheat control in spring wheat.

RCB; 3 reps
Variety: Dixon
Planting Date: 4/5/04
POST: 5/20/04; wheat 4 lf, 12-14"; Wibw 3-6"
Soil: Clay loam; 2.8% OM; 6.3 pH

Precipitation:
POST: 1st week 1.95 inches
2nd week 0.42 inches

Wibw=Wild buckwheat

COMMENTS: Moderate wild buckwheat. Several satisfactory treatments.

Treatment	*Rate/A*	*% Wibw 7/20/04*
Check	----	0
POSTEMERGENCE		
2,4-D ester	.5 pt	53
Hi-Dep	1 pt	43
Bronate Advanced	.8 pt	80
Bronate Advanced	1.2 pt	88
Clarity+2,4-D amine	2 oz+8 oz	77
Clarity+2,4-D amine	4 oz+8 oz	88
Aim EW+2,4-D amine	.5 oz+8 oz	63
Harmony GT XP+2,4-D ester+NIS	.4 oz+8 oz+.25%	75
Curtail	2 pt	88
Ally Extra+2,4-D ester+NIS	.3 oz+8 oz+.25%	85
Starane+Curtail M	8.15 oz+29 oz	92
LSD (.05)		12

Table 3. Wild oat control in spring wheat.

RCB: 3 reps
Planting Date: 4/5/04
Variety: Oxen
POST: 5/20/04; wheat 3-4 lf; 5-6"
Wioa 1-2 lf; 3-4"

Precipitation:
POST: 1st week 1.95 inches
2nd week 0.42 inches

Wioa=Wild oat

COMMENTS: Variable wild oat density. No apparent treatment differences.

Treatment	*Rate/A*	*% Wioa 7/20/04*	*% Wioa 8/5/04*
Check	----	0	0
POSTEMERGENCE			
Discover NG	18 oz	75	73
Puma	.67 pt	80	76
Everest+NIS	.6 oz+.25%	68	81
Silverado+MSO	1.78 oz+1.5 pt	76	75
Puma+Clarity	.67 pt+.25 pt	81	77
Puma+Harmony GT XP	.67 pt+.4 oz	81	80
Puma+AimEW	.67 pt+.5 oz	73	73
Puma+Starane	.67 pt+.67 pt	78	77
Puma+Bronate Advanced	.67 pt+.8pt	73	68
Discover NG+Bronate Advanced	16 oz+.8 pt	73	73
Silverado+Bronate Advanced+MSO	1.78 oz+.8 pt+1.5 pt	60	70
LSD (.05)		12	12

Table 4. Volunteer express sunflower control in spring wheat.

RCB; 3 reps
Planting Date: 4/27/04
Variety: Oxen
POST: 5/2/04; wheat 6-7 lf, 6-10"
Vost 3-8"
Soil: Clay loam; 2.1% OM; 6.4 pH

Precipitation:
POST: 1st week 0.95 inches
2nd week 3.00 inches

VCRA=Visual Crop Response Rating
(0=no injury; 100=complete kill)
Vost=Volunteer sunflower

COMMENTS: Evaluate volunteer Express sunflower control in wheat. Non SU herbicides were very effective.

Treatment	Rate/A	S Wheat % VCRA 6/5/04	% Vost Express 6/5/04
Check	—	0	0
POSTEMERGENCE			
2,4-D ester	12 oz	0	98
Clarity	4 oz	7	98
Bromate Advanced	.8 pt	0	98
Harmony GT XP+NIS	.45 oz+.5%	0	0
Ally XP+NIS	.6 oz+.5%	13	0
Starane	.67 pt	0	98
MCPA ester	12 oz	0	98
Stinger	.33 pt	0	98
Aim EW+NIS	.5 oz+.5%	0	20
LSD (.05)		2	3

Table 5. No-till corn demonstration.

RCB: 3 reps
Planting Date: 4/27/04
Variety: DeKalb DKC 44-46
EPP: 4/[illegible]/04
PRE: 4/27/04
POST: 6/14/04; Corn V3-4, 8-10"
Grft 3-4 fl, 2-5"; KOCZ 1-4"
Soil: Clay loam, 2.8% OM; 6.3 pH

Precipitation:
EPP: 1st week 0.00 inches
2nd week 0.00 inches
PRE: 1st week 0.00 inches
2nd week 0.55 inches
POST: 1st week 0.75 inches

Grft=Green foxtail
KOCZ=Kochia

COMMENTS: Delayed weed emergence. Preemerge treatments performed better than expected with dry early conditions but contributed to late season control. Postemerge treatments provided satisfactory grass control and very good kochia control. Low rates of atrazine were important component for kochia.

Treatment	*Rate/A*	*% Grft 8/5/04*	*% KOCZ 8/5/04*
Check	----	0	0
EARLY PREPLANT			
Bicep Lite II Magnum	2 qt	91	91
Harness Xtra	2 qt	88	95
Balance Pro+atrazine	2.25 oz+1.5 pt	83	95
Lumax	2.5 qt	95	97
PREEMERGENCE			
Harness Xtra	2 qt	85	27
EARLY PREPLANT & POSTEMERGENCE			
Outlook&Distinct+NIS+28% N	21 oz&4 oz+.25%+2 qt	92	95
Dual II Magnum& Callisto+NIS+28% N	1.67 pt&3 oz+.25%+2 qt	91	93
Atrazine+Roundup UltraMax II+AMS	1 qt&21 oz+2.5 lb	82	95
Harness Xtra&Roundup UltraMax II+AMS	1 qt&21 oz+2.5 lb	89	95
Harness&Starane+atrazine	2.25 pt& 66 pt+1 pt	92	95
POSTEMERGENCE			
Marksman+NIS	3 pt+.25%	23	95
Steadfast ATZ+COC+28% N	14 oz+1%+2 qt	92	94
Steadfast ATZ+Callisto+COC+28% N	14 oz+2 oz+1%+2 qt	89	95
Option+Marksman+MSO+28% N	1.5 oz+2 pt+1 pt+2 qt	87	95
Roundup UltraMax II+AMS	21 oz+2.5 lb	87	94
Roundup UltraMax II+atrazine+AMS	21 oz+1.5 pt+2.5 lb	91	95
Roundup UltraMax II+Clarity+AMS	21 oz+3 oz+2.5 lb	90	94
LSD (.05)		7	5

Table 6. Soybean herbicide demonstration

RCB; 3 reps
Planting Date: 6/2/04
Variety: Asgrow AG 1401
PRE: 6/2/04
EPOST: 7/12/04; Soybean 3-4 tri, 6-7"
Grft 3-4 lf, 3-6"; KOCZ 2-8"
POST: 7/20/04; Soybean Bloom, 10"
Grft 5-6 lf; 4-8"; KOCZ 4-10"
Soil: Clay loam, 2.8% OM; 6.3 pH

Precipitation:
PRE: 1st week 0.90 inches
2nd week 3.00 inches
EPOST: 1st week 0.45 inches
2nd week 0.15 inches
POST: 1st week 0.25 inches
2nd week 2.12 inches

Grft=Green foxtail
KOCZ=Kochia

COMMENTS: Roundup Ready soybeans. Glyphosate treatments provided excellent control; very limited late season weed flush.

Treatment	*Rate/A*	*% Grft 8/5/04*	*% KOCZ 8/5/04*
Check	----	0	0
EARLY POSTEMERGENCE			
Roundup UltraMax II+AMS	22 oz+2.5 lb	97	96
POSTEMERGENCE			
Roundup UltraMax II+AMS	22 oz+2.5 lb	96	98
EARLY POSTEMERGENCE & POSTEMERGENCE			
Roundup UltraMax II+AMS& Roundup UltraMax II+AMS	22 oz+2.5 lb& 22 oz+2.5 lb	98	98
PREEMERGENCE & POSTEMERGENCE			
Authority&Roundup UltraMax II+AMS	4 oz&22 oz+2.5 lb	98	98
Sencor&Roundup UltraMax II+AMS	4 oz&22 oz+2.5 lb	96	98
Valor&Roundup UltraMax II+AMS	2 oz&22 oz+2.5 lb	97	98
Valor+Python&Roundup UltraMax II+AMS	2 oz+1 oz&22 oz+2.5 lb	98	98
EARLY POSTEMERGENCE			
Extreme+AMS	3 pt+2.5 lb	98	98
POSTEMERGENCE			
Select+Harmony GT XP+FirstRate+ NIS+AMS	6 oz+.083 oz+.3 oz+ 25%+2.5 lb	57	30
LSD (.05)		2	3

Table 7. Grain sorghum demonstration.

RCB; 3 reps
Planting Date: 6/2/04
Variety: DK 28E
PRE: 6/2/04
POST: 7/12/04; Sorghum V4-5, 8-14"
Grft 3-4 lf, 3-6"; KOCZ 3-6"

Precipitation:
PRE: 1st week 0.90 inches
2nd week 3.00 inches
POST: 1st week 0.45 inches
2nd week 0.15 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Grft=Green foxtail
KOCZ=Kochia

COMMENTS: Good preemergence activity. Weeds variable at postemerge timing; some grasses exceeded optimum size.

Treatment	*Rate/A*	*% VCRR Root 6/5/04*	*% Grft 6/5/04*	*% KOCZ 6/5/04*
Check	—	0	0	0
PREEMERGENCE				
Bicep Lite II Magnum	1.5 qt	0	90	93
Outlook	19 oz	0	89	40
PREEMERGENCE & POSTEMERGENCE				
Outlook&Buctril	19 oz&1 pt	0	89	85
Outlook&Buctril+atrazine	19 oz&1 pt+1.5 pt	0	93	96
Outlook&Clarity	19 oz&6 oz	8	91	90
Outlook&Basagran+atrazine	19 oz&1 pt+1.5 pt	0	93	88
Outlook&2,4-D amine	19 oz&1.5 pt	17	91	68
POSTEMERGENCE				
Paramount+COC+28% N	5.33 oz+1%+2.5%	0	74	27
Paramount+atrazine+COC+28% N	5.33 oz+1.5 pt+1%+2.5%	0	76	25
LSD (.05)		2	4	7

Table 6. Weed control in sunflowers.

RCB; 3 reps
Planting Date: 6/2/04
Variety: CL.-6N429CL
PPI/PRE: 6/2/04
POST: 7/12/04; Sunflower 14-20"
Grft 3-4 lf, 4-8"; Colq 2-4"; Rrpw 2-5"
Soil: Clay loam, 2.3% OM; 6.5 pH

Precipitation:
PPI/PRE: 1st week 0.90 inches
2nd week 3.00 inches
POST: 1st week 0.45 inches
2nd week 0.15 inches

Grft=Green foxtail
Colq=Common lambsquarter
Rrpw=Redroot pigweed

COMMENTS: Conventional till sunflower. Clearfield hybrid. Data identifies satisfactory programs.

Treatment	*Rate/A*	*% Grft 8/5/04*	*% Colq 8/5/04*	*% Rrpw 8/5/04*
Check	—	0	0	0
PREPLANT INCORPORATED				
Treflan	2 pt	85	79	85
Sonalan	3 pt	88	91	92
PREPLANT INCORPORATED & PREEMERGENCE				
Treflan&Spartan	2 pt&4 oz	92	97	97
PREEMERGENCE				
Spartan	4 oz	79	96	97
PREEMERGENCE & POSTEMERGENCE				
Spartan&Select+COC	4 oz&6 oz+1%	97	97	96
POSTEMERGENCE				
Poast+COC	1 pt+1%	98	0	0
PREPLANT INCORPORATED				
Prowl H2O	3.5 pt	83	86	87
PREPLANT INCORPORATED & POSTEMERGENCE				
Prowl H2O&Beyond+NIS+28% N	3 pt&4 oz+.25%+2.5%	92	91	95
POSTEMERGENCE				
Beyond+NIS+28% N	4 oz+.25%+2.5%	69	71	75
LSD (.05)		7	7	6

Table 9. No-till sunflower demonstration.

RCB; 3 reps
Planting Date: 6/2/04
Variety: See comments
EPP: 4/22/04
PRE: 6/2/04
POST: 7/12/04; Sunflower 12-16"
Grft 3-6 lf; 4-12"; KOCZ 6-16"
Soil: Clay loam; 2.6% OM; 6.5 pH

Precipitation:
EPP: 1st week 0.00 inches
2nd week 0.00 inches
PRE: 1st week 0.90 inches
2nd week 3.00 inches
POST: 1st week 0.45 inches
2nd week 0.15 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Grft=Green foxtail
KOCZ=Kochia

COMMENTS: Evaluation of weed programs in sunflower. Variable weed size. Data suggest possible significant ALS resistant biotypes in kochia population.

Treatment	*Rate/A*	*% VCRR 8/5/04*	*% Grft 8/5/04*	*% KOCZ 8/5/04*
	PIONEER 63M80			
Check	---	0	0	0
EARLY PREPLANT				
Spartan	3.5 oz	0	81	95
Spartan	5 oz	0	85	96
Prowl H_2O+Spartan	3.1 pt+3.5 oz	0	91	96
Dual II Magnum	2 pt	0	93	10
Dual II Magnum+Spartan	1.75 pt+3 oz	0	89	91
EARLY PREPLANT & PREEMERGENCE				
Spartan&Spartan	2 oz&1.5 oz	0	89	94
PREEMERGENCE & POSTEMERGENCE				
Prowl H_2O&Poast+COC	3.1 pt&1 pt+1%	0	97	52
EARLY PREPLANT & POSTEMERGENCE				
Spartan&Select+COC	3.5 oz&6 oz+1%	0	98	94
POSTEMERGENCE				
Beyond+NIS+28% N	4 oz+.25%+1%	97	85	22
Express XP+NIS	.33 oz+ 5%	93	0	47
	CLEARFIELD - CL8N429			
POSTEMERGENCE				
Beyond+NIS+28% N	4 oz+.25%+1%	0	95	12
Beyond+NIS+28% N	8 oz+.25%+1%	0	95	25
PREEMERGENCE & POSTEMERGENCE				
Prowl H_2O&Beyond+NIS+28% N	3.1 pt&4 oz+.25%+1%	0	95	78
Spartan&Beyond+NIS+28% N	3.5 oz&4 oz+.25%+1%	0	98	97
LSD (.05)		1	4	8

Table 10. Chickpea demonstration.

RCB; 3 reps
Planting Date: 4/15/04
Variety: 8-90
PRE: 4/15/04
POST: 6/3/04; Chickpea 5-7"
Colq 1-3"; Grft 1-2 lf, 1-2"
Soil: Clay loam; 2.1% OM; 6.5 pH

Precipitation:
PRE: 1st week 0.00 inches
2nd week 0.00 inches
POST: 1st week 1.50 inches
2nd week 2.40 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Grft=Green foxtail
Colq=Common lambsquarters

COMMENTS: Screening evaluation for chickpea herbicides. Crop tolerance was acceptable for most treatments except Raptor. Basagran appeared to provide a safening effect for Raptor.

Treatment	*Rate/A*	*% VCRR 6/3/04*	*% VCRR 8/5/04*	*% Grft 8/5/04*	*% Colq 8/5/04*	*Yield lb/A*
Check	----	0	0	0	0	1298
PREEMERGENCE						
Sencor	.33 lb	0	0	80	73	1541
Princep	1 qt	0	0	75	40	1597
Prowl H_2O	3.5 pt	0	0	85	82	1489
Pursuit Plus	2.5 pt	15	8	90	80	1139
Outlook	19 oz	0	0	88	18	1537
Callisto	6 oz	7	2	46	73	1354
Spartan	4 oz	0	3	88	85	1563
Spartan	8 oz	2	2	92	95	1488
Axiom	7 oz	0	0	87	25	1417
Axiom	14 oz	3	3	85	23	1425
Pursuit 2L	3 oz	13	7	90	45	1380
Pursuit 2L	6 oz	25	13	90	32	1221
Raptor	4 oz	13	13	90	40	760
Dual II Magnum	1.67 pt	3	2	90	38	1358
Degree	4.25 pt	2	5	90	68	1379
Command3ME	1.5 pt	43	2	89	76	1353
POSTEMERGENCE						
Raptor+NIS+28% N	4 oz+.25%+1%	—	62	94	81	122
Raptor+Basagran+ NIS+28% N	4 oz+1 pt+ 25%+1%	—	28	91	93	756
Aim EW+NIS+28% N	.5 oz+.25%+1%	—	10	0	88	1497
LSD (.05)		4	6	13	18	319

Table 11. Field pea weed control.

RCB; 3 reps
Planting Date: 4/15/04
Variety: Toledo
PPI/PRE: 4/15/04
POST: 6/3/04; Field pea 3-6"
Grft 1-2 lf; 1-2"; KOCZ 1-3"
Soil: Clay loam; 2.1% OM; 6.5 pH

Precipitation:
PPI/PRE: 1st week 0.00 Inches
2nd week 0.00 Inches
POST: 1st week 1.50 Inches
2nd week 2.40 inches

Grft=Green foxtail
KOCZ=Kochia

COMMENTS: Moderate weed pressure. Several treatments provided satisfactory foxtail control. Spartan and Raptor+Basagran exceeded 90% kochia control. Data suggests partial ALS resistant kochia population.

Treatment	*Rate/A*	*% Grft 8/3/04*	*% KOCZ 8/3/04*	*Yield lbs/A*
Check	---	0	0	1565
PREPLANT INCORPORATED				
Dual II Magnum	2 pt	92	15	1457
Prowl H_2O	2.17 pt	90	60	1480
Treflan	1.5 pt	90	83	1617
Sonalan	2 pt	90	78	1771
PREEMERGENCE				
Outlook	21 oz	90	33	1684
Spartan	5.33 oz	82	95	1769
Sencor	.5 lb	55	85	1348
Pursuit 2L	1.08 oz	87	62	1561
POSTEMERGENCE				
Pursuit DG+NIS	1.08 oz+.25%	90	77	1711
Raptor+NIS	4 oz+.25%	90	43	1621
Raptor+Basagran+NIS	4 oz+2 pt+.25%	90	93	1379
Poast+Basagran+COC	1.5 pt+2 pt+1 pt	92	85	1354
Assure II+COC	7 oz+1 pt	98	0	1546
Select+COC	7 oz+1 pt	98	0	1654
Thistrol	4 pt	35	42	1582
LSD (.05)		13	18	228

Table 12. Weed control in safflower.

RCB: 3 reps
Planting Date: 4/15/04
Variety: Finch
SPPI/PRE: 4/15/04
POST: 6/3/04; Safflower 2-6"
Grft 1-2 lf. 1-2"; KOCZ 1-3"; Colq 1-3"
Soil: Clay loam; 2.1% OM; 6.7 pH

Precipitation:
SPPI/PRE: 1st week 0.00 inches
2nd week 0.00 inches
POST: 1st week 1.50 inches
2nd week 2.40 inches

Grft=Green foxtail
KOCZ=Kochia
Colq=Common lambsquarters

COMMENTS: Moderate weed density. No treatment effect on stand or maturity. Spartan and Valor provided good broadleaf weed control; no adverse crop response.

Treatment	Rate/A	% Grft 6/5/04	% KOCZ 6/5/04	% Colq 6/5/04	Yield lbs/A
Check	---	0	0	0	608
SHALLOW PREPLANT INCORPORATED					
Treflan	1 qt	93	43	33	827
Sonalan	1.5 qt	93	55	52	814
Dual II Magnum	2 pt	92	38	40	831
PREEMERGENCE					
Dual II Magnum	2 pt	90	35	28	705
Outlook	19 oz	89	45	30	750
PREEMERGENCE & POSTEMERGENCE					
Spartan&Poast+COC	4 oz&1 pt+1 pt	94	92	94	685
Spartan&Poast+COC	8 oz&1 pt+1 pt	95	96	96	820
Valor&Poast+COC	3 oz&1 pt+1 pt	97	92	83	998
POSTEMERGENCE					
Select+COC	6 oz+1 pt	98	0	0	822
LSD (.05)		5	23	27	191

Table 13. Flax demonstration.

RCB; 3 reps
Planting Date: 4/15/04
Variety: Selby
SPPI/PRE: 4/15/04
POST: 6/3/04; Flax 3-7"
Grft 1-2 II, 1-2"; KOCZ 2-4"; Colq 2-5"
Soil: Clay loam, 2.1% OM; 6.7 pH

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

Precipitation:
SPPI/PRE: 1st week 0.00 inches
2nd week 0.00 inches
POST: 1st week 1.50 inches
2nd week 2.40 inches

Grft=Green foxtail
KOCZ=Kochia
Colq=Common lambsquarter

COMMENTS: Evaluation of herbicide for use in flax. Buctril and MCPA provided very good broadleaf control.

Treatment	*Rate/A*	*% VCRR 8/5/04*	*% Grft 8/5/04*	*% KOCZ 8/5/04*	*% Colq 8/5/04*	*Yield bu/A*
Check	—	0	0	0	0	18
SHALLOW PREPLANT INCORPORATED						
Treflan	1.5 pt	0	94	87	5	20
PREEMERGENCE						
Spartan	4 oz	0	85	92	67	20
PREEMERGENCE & POSTEMERGENCE						
Spartan&Poast+COC	4 oz&1 pt+1 qt	0	98	90	71	23
POSTEMERGENCE						
MCPAamine	1 pt	0	0	25	88	18
MCPA ester	1 pt	0	0	88	96	20
Buctril	1 pt	0	0	94	92	16
Buctril+Select	1 pt+7 oz	0	98	96	94	19
Stinger+Poast+COC	.33 pt+1 pt+1 qt	0	98	20	92	14
Curtail M	2.33 pt	0	0	84	96	17
Select	7 oz	0	98	0	0	18
Callisto+COC	3 oz+1 qt	13	0	95	97	12
LSD (.05)		4	2	8	9	NS

Table 14. Evaluation of herbicides on millet.

RCB; 2 reps
Planting Date: 6/8/04
POST: 7/12/04; Sunrise 3-4 lf, 12-16"; Siberian 3-4 lf, 12-14"; Japanese 3-4 lf, 8-12"; German 2-3 lf, 6-10"; Pearl 3-4 lf, 12-14"; Sorg/Sudan 3-4 lf, 18-24"
Soil: Clay loam; 2.1% OM; 6.4 pH

Precipitation:
POST: 1st week 0.45 inches
2nd week 0.15 inches

VCRR=Visual Crop Response Rating
(0=no injury; 100=complete kill)

COMMENTS: Evaluation of crop tolerance to herbicides at X and 2X normal rates. Favorable crop conditions for millet. Tolerance in 2004 appeared greater for some treatments than in previous tests. Data will support special registration requests

		SUNRISE				SIBERIAN				JAPANESE			
Treatment	Rate/A	% VCRR Lodging 7/20/04	% VCRR Lf Burn 7/20/04	% VCRR Lodging 9/21/04	% VCRR Delay 9/21/04	% VCRR Lodging 7/20/04	% VCRR Lf Burn 7/20/04	% VCRR Lodging 9/21/04	% VCRR Delay 9/21/04	% VCRR Lodging 7/20/04	% VCRR Lf Burn 7/20/04	% VCRR Lodging 9/21/04	% VCRR Delay 9/21/04
Check	---	0	0	0	0	0	0	0	0	0	0	0	0
POSTEMERGENCE													
2,4-Damine	8 oz	0	0	0	0	80	0	0	30	0	0	0	0
2,4-Damine	16 oz	0	0	0	0	80	0	0	30	0	0	0	0
Bronate Advanced	.8 pt	0	3	0	0	0	5	0	0	0	3	0	0
Bronate Advanced	1.6 pt	0	5	0	0	0	10	0	0	0	5	0	0
Starane	.5 pt	0	0	0	0	0	0	0	0	0	0	0	0
Starane	1 pt	0	3	0	0	0	0	0	0	0	0	0	0
Clarity	4 oz	0	0	0	0	0	0	0	0	0	5	0	0
Clarity	8 oz	0	0	0	0	0	0	0	0	0	3	0	0
Peak+NIS	.5 oz+.25%	0	0	0	0	0	0	0	0	0	0	0	0
Peak+NIS	1 oz	0	0	0	0	0	0	0	0	0	0	0	0
AimEW+NIS	.5 oz	0	10	0	0	0	15	0	0	0	10	0	0
Aim EW+NIS	1 oz	0	15	0	0	0	15	0	0	0	10	0	0
LSD (05)		0	3	0	0	0	4	0	0	0	6	0	0

		GERMAN				PEARL				SORGHUM/SUDAN			
Treatment	Rate/A	% VCRR Lodging 7/20/04	% VCRR Lf Burn 7/20/04	% VCRR Lodging 9/21/04	% VCRR Delay 9/21/04	% VCRR Lodging 7/20/04	% VCRR Lf Burn 7/20/04	% VCRR Lodging 9/21/04	% VCRR Delay 9/21/04	% VCRR Lodging 7/20/04	% VCRR Lf Burn 7/20/04	% VCRR Lodging 9/21/04	% VCRR Delay 9/21/04
Check	---	0	0	0	0	0	0	0	0	0	0	0	0
POSTEMERGENCE													
2,4-D amine	8 oz	0	0	20	0	0	0	0	0	0	0	0	0
2,4-D amine	16 oz	0	0	30	0	0	0	0	0	0	0	0	0
Bronate Advanced	.8 pt	0	0	0	0	0	0	0	0	0	0	0	0
Bronate Advanced	1.6 pt	0	0	0	0	0	0	0	0	0	0	0	0
Starane	.5 pt	0	0	0	0	0	0	0	0	0	0	0	0
Starane	1 pt	0	3	0	0	0	0	0	0	0	0	0	0
Clarity	4 oz	0	0	0	0	0	0	0	0	0	0	0	0
Clarity	8 oz	0	0	0	0	0	0	0	0	0	0	0	0
Peak+NIS	.5 oz+.25%	0	0	0	0	0	0	0	0	0	0	0	0
Peak+NIS	1 oz	0	0	0	0	0	0	0	0	0	0	0	0
Aim EW+NIS	.5 oz	0	10	0	0	0	10	0	0	0	10	0	0
Aim EW+NIS	1 oz	0	8	0	0	0	10	0	0	0	10	0	0
LSD (.05)		0	3	0	0	0	4	0	0	0	6	0	0

Table 15. Alfalfa demonstration - new seeding.

RCB; 3 reps
Planting Date: 4/15/04
Variety: Vernal
PPI: 4/15/04
EPOST: 6/3/04; Alfalfa 1-2 tri, 1-2";
Grft 1-2 lf, 1-2"; Colq .5-1"; Rrpw 1-4"
POST: 6/14/04; Alfalfa 3-4 trl, 4-5"
Grft 2-3 lf, 3-4"; Colq 2-4"; Rrpw 2-6"

Precipitation:
PPI: 1st week 0.00 inches
2nd week 0.00 inches
EPOST: 1st week 1.50 inches
2nd week 2.40 inches
POST: 1st week 0.75 inches
2nd week 0.55 inches

Grft=Green foxtail
Colq=Common lambsquarter
Rrpw=Redroot pigweed
Hans=Hairy nightshade

COMMENTS: Evaluation of herbicides for new alfalfa seeding. Pursuit, Raptor, and Buctril provided good broadleaf control.

Treatment	*Rate/A*	*% Grft 8/5/04*	*% Colq 8/5/04*	*% Rrpw 8/5/04*	*% Hans 8/5/04*
Oats/Alfalfa	---	95	78	10	
EARLY POSTEMERGENCE					
Oats+Poast Plus+COC	1.5 pt+1 qt	85	82	85	42
Check	---	0	0	0	0
PREPLANT INCORPORATED					
Treflan	1.5 pt	96	82	93	7
EARLY POSTEMERGENCE					
Poast Plus+COC	1.5 pt+1 qt	98	0	0	0
Select+COC	7 oz+1 qt	98	0	0	0
Pursuit DG+MSO+28% N	1.44 oz+1 qt+1 qt	97	90	95	98
Raptor+MSO+28% N	4 oz+1 qt+1 qt	97	97	95	98
POSTEMERGENCE					
Buctril	1.5 pt	0	92	96	97
Buctril+Select+COC	1 pt+7 oz+1 qt	98	86	93	93
Butyrac 200+Select+COC	1.5 pt+7 oz+1 qt	97	90	95	75
LSD (.05)		1	10	3	10

Table 16. Spring alfalfa burndown.

RCB; 3 reps
POST: 4/22/04; Alfalfa 4-6"
Soil: Clay loam; 2.6% OM; 6.5 pH

Precipitation:
POST- 1st week 0.00 inches
2nd week 0.00 inches

ALFZ=Alfalfa

Comments: Spring alfalfa burndown. Most effective control was obtained with 2,4-D or Roundup + 2,4-D.

Treatment	*Rate/A*	*% ALFZ 5/11/04*
Check	—	0
POSTEMERGENCE		
2,4-D ester	1 qt	85
Roundup UltraMax II+AMS	21 oz+2.5 lb	43
Roundup UltraMax II+AMS	42 oz+2.5 lb	50
Roundup UltraMax II+2,4-D ester+AMS	21 oz+1 pt+2.5 lb	99
Curtail	2 pt	77
Stinger	.33 pt	55
2,4-D ester+Clarity	.75 pt+4 oz	82
LSD (.05)		16

Table 17. Kochia burndown.

RCB: 2 reps
BURNDOWN: 6/24/04; KOCZ 4-5"; Wibw 3-6"
Soil: Clay loam; 2.3% OM; 6.5 pH

Precipitation:
1st week 0.85 inches
2nd week 0.30 inches

KOCZ=Kochia
Wibw=Wild buckwheat

COMMENTS: Very heavy kochia, variable buckwheat. Evaluation of fallow herbicides. No apparent antagonisms with tank-mixes.

Treatment	Rate/A	% KOCZ 6/30/04	% KOCZ 7/20/04	% Wibw 7/20/04
Check	---	0	0	0
BURNDOWN				
Roundup Original Max+AMS	22 oz+2.5 lb	48	98	97
Roundup UltraMax II+AMS	22 oz+2.5 lb	33	97	90
Roundup UltraMax II+AMS	11 oz+2.5 lb	25	90	93
ET	1 oz	5	15	50
Roundup UltraMax II+ET+AMS	11 oz+.5 oz+2.5 lb	30	94	60
Roundup UltraMax II+Aim EW+AMS	11 oz+.5 oz+2.5 lb	48	94	94
Roundup UltraMax II+2,4-D ester+AMS	11 oz+1 pt+2.5 lb	65	91	94
Roundup UltraMax II+ Harmony GT XP+AMS	11 oz+ .083 oz+2.5 lb	23	89	80
Roundup UltraMax II+Spartan+AMS	11 oz+3.5 oz+2.5 lb	28	85	98
Roundup UltraMax II+Starane+AMS	11 oz+.5 pt+2.5 lb	76	94	94
Roundup UltraMax II+Buctril+AMS	11 oz+.75 pt+2.5 lb	25	65	98
LSD (.05)		22	13	31

Fertilizer and Soil Test Effects on Wheat

Jim Gerwing, Ron Gelderman, Anthony Bly, and Mike Volek
South Dakota State University

Soil testing research has shown that knowledge of soil test levels can improve the profitability of fertilizer use. Profits increase if more fertilizer is used when soil test levels are low and little or no fertilizer is used when test levels are high. Frequently, however, the major nutrients (N P K) and sometimes zinc and sulfur are applied without a current soil test.

This experiment was initiated to demonstrate the long term effects of applying phosphorus, potassium, zinc, and sulfur regardless of soil test. The intent is to continue the experiment on the same location at the Highmore experiment station for a number of years. The planned rotation is soybean and wheat. The objective is to demonstrate soil testing's ability to predict crop response to fertilizer and fertilizer influence on soil tests.

Materials and methods

The experiment was established on a Glenham loam soil series on the Highmore Experiment Station in 1997. Glenham soils are deep, well drained soils formed in friable glacial till. Fertilizer treatments (Table 1) consisted of phosphorus only (0-46-0), nitrogen only, or phosphorus and nitrogen plus either potassium (0-0-60), sulfur (21-0-0-24), or zinc ($ZnSO_4$-35%). The nitrogen source was urea except part of the N came from ammonium sulfate in the sulfur treatment. Fertilizer was broadcast on April 4, 2004, and Briggs spring wheat no till planted into the soybean residue on April 13. Fertilizer treatments have been applied on the same plots since 1997. Fertilizer rates were the same each year except nitrogen that varied according to soil test. Plot size in this experiment is 25 feet by 50 feet. Harvest is done with a small plot combine.

Results and discussion

Soil analysis on samples taken on March 30, 2004 is reported in Table 2. The 50 lb of nitrogen applied to the previous soybean crop increased soil residual nitrate by 44 lb/a over where no nitrogen had been applied since the start of the study in 1997. No nitrogen would have been recommended for soybeans. For this study, however, 50 lb of N had been applied to determine its influence on soybean yield. Drought in 2003 severely limited soybean yields and resulted in very high nitrate carryover level for wheat this year.

The sulfur soil test was high and no sulfur would have been recommended. Previous applications of sulfur increased sulfur soil test by 86 lb/a. The 25 lb of phosphorus and 50 lb of potassium applied each year since 1997 increased phosphorus soil test from 10 ppm in the check to 28 ppm and potassium soil test from 459 to 533 ppm. The phosphorus test (10 ppm) was in the medium range and 20 lb of phosphorus fertilizer would have been recommended for a 50-bu wheat yield goal. The potassium soil test was very high and none would have been recommended. The zinc soil test was raised from 0.86 ppm to 5.14 ppm by the annual addition of 5 lb of zinc for 5 years. The check zinc soil test (0.86 ppm) was in the high soil test range. No zinc would have been recommended regardless of soil test since wheat does not usually respond to zinc fertilization.

Wheat yields are reported in Table 1. Dry conditions caused severe stress early in the season, but moisture and cool conditions after heading resulted in wheat yields averaging 49 bu/a. The nitrogen-only treatment had a yield of 43 bu/a while all treatments receiving phosphorus averaged 50 bu/a.

Although a yield increase to phosphorus would be expected with a 10 ppm phosphorus soil test, the 7 bushels here were not statistically different from other treatments due to plot variability likely caused be early season drought stress. There was no response to potassium, sulfur, or zinc treatment, and none was expected since soil tests were very high. The carryover nitrogen level of 98 lb/a plus N supplied by the soybean credit was enough for maximum yield, and adding 50 lb as fertilizer N did not increase yield. The fertilizer nitrogen, however, did increase wheat protein by 2.2 % to 15.2%.

This site will be rotated back to soybeans in 2005. Similar fertilizer treatments will be applied to the same plots. Yields and soil tests from the previous years of this study can be found in the 1997 - 2003 Highmore annual reports or in the 1997 - 2003 SDSU Plant Science Department Soil/Water Science Research Annual Report, TB 99.

Support for these studies came from various sources including the Ag Experiment Station, Plant Science Department, Extension Service, and the SDSU Soil Testing Lab.

Table 1. Wheat yield, fertilizer trial, Highmore, 2004

Fertilizer treatment	Wheat Yield	Protein
lb/a	bu/a	%
1. 0 N + 35 P	53	13.0 a
2. 50 N + 0 P	43	15.2 b
3. 50 N + 35 P	47	15.3 b
4. 50 N + 35 P + 50 K	53	15.4 b
5. 50 N + 35 P + 25 S	49	15.0 b
6. 50 N + 35 P + 5 Zn	48	15.2 b
Pr. > F	0.20	.001
CV %	12.2	3.9
LSD	NS	0.88

Table 2. Soil test levels, Highmore, 2004.

Soil test[1]	Check	Treated
Nitrate-N, lb/a		
0 – 6 in.	12	16
6 in. – 24 in.	86	126
Sulfate-S, lb/a		
0 – 6 in.	8	20
6 in. – 24 in.	86	140
Phosphorus, ppm	10	28
Potassium, ppm	439	533
Zinc, ppm	0.86	5.14
OM, %	2.8	
pH	8.3	
Salts, mmho/cm	0.3	

[1] Sampled 3/30/04

Aphid Infestations, Barley Yellow Dwarf Incidence, Plant Growth, and Yield of Winter Wheat in Relation to Planting Date and Seed Treatment

Louis Hesler and **Walter Riedell**, Northern Grain Insects Research Laboratory, USDA-ARS, Brookings
Marie Langham, Plant Science Department, South Dakota State University

Summary

1. Winter wheat was planted on four dates in 2003 (Aug 27, Sep 8, and Sep 17 and 29), and seed in each planting was treated with either Gaucho XT (insecticide) + Raxil MD (fungicide) or Raxil MD only. Cereal-aphid infestations, incidence of barley yellow dwarf, and plant growth and yield were measured. Aphid data, plant growth, and yield results are summarized in this report.

2. Cereal aphid infestations in fall 2003 and spring 2004 were low (less than 0.3 aphid per 20 tillers) across all plantings and seed treatments. These low infestations would not have impacted yield directly.

3. Seed treatment had no effect upon leaf area index (at boot stage), grain yield, or yield components (as measured by hand harvest). The 17 September planting date had the greatest leaf area index, individual seed weight, and yield. Combine harvest data revealed that yields and test weights (50.5 bu/a and 54.6 lb/bu, respectively) did not differ among plantings or by seed treatment.

Introduction

Our previous research has shown that delayed planting of winter wheat can lower cereal aphid numbers and incidence of barley yellow dwarf (BYD) disease in South Dakota. The BYD virus is transmitted to plants by cereal aphids. Insecticides can also limit cereal aphid infestations and barley yellow dwarf incidence in wheat. Treating seed is one method of delivering insecticide for aphid control. However, the benefit of using insecticide-treated seed may decline with later plantings of winter wheat as cereal aphid pressure declines. Our objective was to compare cereal-aphid infestations, barley yellow dwarf incidence, and the growth and yield of winter wheat at various planting dates of wheat with and without insecticide-treated seed.

Materials and methods

Winter wheat plots. Winter wheat ('Crimson') was sown at four planting dates (Aug. 27, Sep. 8, and Sep. 17 and 29, 2003) into eight 12-by-60 ft^2 plots at the Central Research Station at Highmore. This set of eight plots was replicated four times for a total of 32 plots. For each planting date, half of the number of plots was planted with seed treated with Gaucho XT (insecticide) + Raxil MD (fungicide), and seed planted in the other half was treated with Raxil MD (fungicide) only. Seed was sown about 1 in deep using a Kirschman drill in furrows about 12 in apart. Fertilizer was applied just before (40-0-0, N-P-K; 100 lb ac^{-1}) and at planting (14-36-13; 52 lb ac^{-1}).

Insect sampling. We sampled 20 tillers (four groups of five plants) per plot for cereal aphids at approximately 20 and 40 days after each planting in each plot. We sampled 20 tillers per plot for aphids in May 2004.

Leaf area measurements. The ratio of wheat leaf area to the ground area upon which the wheat was grown was measured using the leaf-area index (LAI) feature of the LAI-2000 crop canopy analyzer. An above-canopy reference measurement was used as a benchmark for four within-canopy measurements per plot. Data were averaged across treatments and standard error of data means calculated using SAS software. Additionally, data were analyzed using analysis of variance methods. With the occurrence of a significant F value, treatment means were separated using the LSD test.

Yield data. Plots were harvested by hand on 21 July 2004. Hand-harvest yield was derived by taking three 1-foot sections of row per plot. Plants were cut at the ground level using scissors. Leaves, stems, and grain heads were placed into paper bags and dried to ambient humidity in a greenhouse. The number of heads was determined, and the grain was manually separated from the chaff. Total grain weight and individual kernel weight was then measured. Data were

averaged across treatments and standard error of data means calculated using SAS software. Additionally, data were analyzed using analysis of variance methods. With the occurrence of a significant *F* value, treatment means were separated using the LSD test.

Combine yield was taken from two 6-ft wide combine strips within each plot on July 27; exact measurements of strips were made immediately after each combine pass. Test weight and moisture content of combined grain were measured using a Dickey-John seed tester. Moisture was measured for each combine strip sample, and moisture subtracted to produce a measurement of dry grain mass. Combine yield data were subjected to a factorial analysis of variance using SAS software.

Results and discussion

Insects. Cereal aphid infestations in fall 2003 and spring 2004 were low (less than 0.3 aphid per 20 tillers) and did not differ among plantings and seed treatments. These low infestations could not have directly impacted growth and yield of wheat.

Leaf area measurements. Descriptive statistics from leaf area index measurements showed differences due to planting date but not insecticide treatment (Table 1). Statistical analysis revealed a significant *F* for planting date but not insecticide treatment. There was no significant interaction between planting date and insecticide treatment, indicating that leaf area index did not respond differently to insecticide treatments across planting dates. Mean separation for planting date data pooled across insecticide treatments revealed that the 17 September planting date had the greatest leaf area index (Table 2).

Yield. Descriptive statistics from yield measurements showed differences due to planting date but not insecticide treatment (Table 1). Statistical analysis revealed a significant *F* for planting date but not insecticide treatment for the all dependent variables. There were no significant interactions between planting date and insecticide treatment for any of the dependent variables, indicating that the yield components and yield did not respond differently to insecticide treatments across planting dates. Mean separation for planting date data pooled across insecticide treatments revealed that the 17 September planting date had the greatest individual seed weight and yield, while the 27 August planting date had the lowest total heads and total seeds per foot of row and lowest seed weight and yield (Table 2).

Combine-harvest samples showed no statistical differences ($P > 0.05$) in yield (50.5 bu/a) or test weight (54.6 lb/bu) due to planting date or seed treatment.

Acknowledgments

We thank Mike Volek and Cecil Tharp for establishing the winter wheat, and Dave Schneider, David Mills, Cecil Tharp, Megan DeBoer, Kendra Jensen, and Hanna Fetzer for assistance in sampling wheat plots. We also thank Max Pravacek and Mike Volek for harvesting the wheat.

Financial support for this research was provided by the USDA Agricultural Research Service, the SDSU Agricultural Experiment Station, and the Plant Science Department.

Table 1. Descriptive statistics of crop canopy (LAI) and yield measurement from hand harvest of winter wheat plots on 21 July 2004 at the Central Research Station, Highmore S.D.

Planting Date	Crop canopy[b] (LAI)	Total heads (per foot of row)	Total seeds	Seed weight (g per seed)	Yield (g foot^{-1})
	Seed treatment with Raxil MD (fungicide) only				
27 August	1.86 ± 0.05	70 ± 5	913 ± 103	0.0141 ± 0.0008	13 ± 2
8 Sept	1.81 ± 0.08	74 ± 3	1548 ± 65	0.0208 ± 0.0004	32 ± 2
17 Sept	2.11 ± 0.11	69 ± 2	1766 ± 84	0.0238 ± 0.0004	42 ± 2
29 Sept	1.82 ± 0.13	79 ± 5	1710 ± 147	0.0201 ± 0.0005	35 ± 4
	Seed treatment with Gaucho XT (insecticide) + Raxil MD				
27 August	1.79 ± 0.05	66 ± 3	1032 ± 131	0.0144 ± 0.0013	16 ± 4
8 Sept	1.73 ± 0.07	72 ± 2	1512 ± 143	0.0201 ± 0.0015	29 ± 2
17 Sept	2.15 ± 0.06	77 ± 2	1704 ± 66	0.0226 ± 0.0006	39 ± 2
29Sept	1.98 ± 0.06	77 ± 2	1762 ± 79	0.0217 ± 0.0004	38 ± 2

[a] Values represent average (± standard error) for 4 replicates of winter wheat planting date treatments.
[b] Crop canopy characteristics were measured with a LAI-2000 leaf area index (LAI) meter between 18 May and 21 May 2004.

Table 2. Statistical analysis results from crop canopy and yield measurements from hand harvest of winter wheat plots on 21 July 2004 at the Central Research Station, Highmore S.D.

Planting Date	Crop canopy[a] (LAI)	Total heads (per foot of row)	Total seeds	Seed weight (g per seed)	Yield (g foot^{-1})
27 August	1.83 bc[b]	68 b	972 c	0.0143 c	15 c
8 Sept	1.77 c	73 ab	1530 b	0.0205 b	31 b
17 Sept	2.13 a	73 ab	1735 a	0.0232 a	40 a
29Sept	1.90 b	77 a	1736 a	0.0209 b	37 a

[a] Crop canopy characteristics were measured with a LAI-2000 leaf area index (LAI) meter between 18 May and 25 May 2004.
[b] Values followed by the same letter are not significantly different (P=0.05, LSD test).

Small Grain Variety Performance Trials

R. G. Hall, K. K. Kirby, and L. Hall
South Dakota State University

This is a report of the 2004 Nelson Brothers Farm performance trials for hard red spring wheat, oat, and barley varieties and experimental lines conducted by the SDSU Crop Performance Testing (CPT) program. Only data generated in year 2004 are reported since this was the first year of testing at this location. These trials were seeded and harvested by L. Hall, research associate, SDSU Oat Breeding Project, and were located about 8 miles south and one mile east of St. Lawrence, S.D.

Experimental procedures

Four plots measuring 5 x 20 feet for each entry were seeded and later cut back to a uniform dimension prior to harvest. A cone-drill seeder with seven seed tubes spaced on 7-inch rows was used. Plots were seeded at 1.2 million pure-live-seeds per acre on April 5, 2004, into a Williams-Bonilla loam previously cropped to soybeans.

Research funding and support sources were the South Dakota Agricultural Experiment Station and testing fees obtained from the South Dakota Crop Performance Testing Program.

Measurements of performance

Yield (bu/a) and bushel weight (lb) values are an average of four replicates. Yields are adjusted to 13.5% grain moisture (dry matter basis) and bushel weights of 60 (wheat), 32 (oat), or 48 lb (barley). Grain protein values were obtained from one sample per entry as determined by a FOSS TECATOR Model Infratec 1229 grain analyzer. Yield values are reported for year 2004 and for 3 years (2002-04), while bushel weight and grain protein values are reported for year 2004.

Performance results

Hard red spring wheat. As indicated in Table 1, the average yield for 2004 was 57 bu/a and varieties had to yield 61 bu/a to be in the top performance group for yield. The top performance group for yield included the varieties Briggs, Oxen, Reeder, Norpro, and Mercury, and the experimental lines SD 3747, SD3868.

In 2004, the average bushel weight was 53 lb, the average grain protein was 15.2%, and the average plant height was 35 inches. In 2004, varieties with a bushel weight of 55 lb or higher were in the top performance group for bushel weight. This included the varieties Ingot, Oklee, Dandy, Mercury, and Granite, and the experimental lines SD 3623 and MN 97803A. The varieties Dapps, Oklee, the check variety Chris, Granite, and Polaris, and the experimental lines SD 3618, SD 3668, and MN 97803A had the higher grain protein values. Entries had to attain a height of 37 inches or more to be in the top performance group for maximum plant height. This group included the varieties Ingot, Granger, Dapps, Russ, the check variety Chris, Dandy, and the experimental lines SD 33623 SD3635, SD 3668, SD 3827, and SD 3860. In contrast, entries had to attain a height of 32 inches or less to be in the top performance group for minimum plant height. This group included the variety Trooper and the experimental line SD 3746.

Oat. As indicated in Table 2, the average yield for 2004 was 119 bu/a and varieties had to yield 119 bu/a to be in the top performance group for yield. The top performance group for yield included the varieties Jerry, Morton, and HiFi and all of the experimental lines tested.

In 2004, the average bushel weight was 39 lb, the average grain protein was 15.4%, and the average plant height was 38 inches. Varieties with a bushel weight of 41 lb or higher were in the top performance group and included Hytest, the hulless variety Buff, and the experimental lines SD 366-7, SD010062, and SD 366-36. Hytest, the hulless variety Paul, and the experimental line SD 366-15 tended to have the high grain protein. Entries had to attain a height of 39 inches or more to be in the top performance group for maximum plant height. This group included the varieties Reeves, Hytest, Morton, Loyal, the hulless varieties Stark and Paul, and the experimental lines SD 366-7, SD010062, SD 366-15, and SD 366-23. In contrast, entries had to attain a height of 34 inches or less to be in the top performance group for minimum plant height. This group included the variety Don and the hulless variety Buff.

Table 1. Hard red spring wheat performance results - Nelson Brothers, Miller, S.D., 2003-2004.

Variety	(Hdg)*	Bu/a 2004	Bu/a 3-yr	Bu wt lb	Prot %	Ht in
Ingot	(1)	54	.	55	16.3	39
Trooper	(1)	59	.	52	15.0	29
Forge	(1)	58	.	51	14.9	35
Walworth	(2)	58	.	52	13.4	34
Briggs	(2)	63	.	53	14.8	34
Granger	(2)	51	.	53	14.0	37
Freyr	(3)	60	.	53	15.3	34
Dapps	(4)	50	.	51	16.9	40
Steele-ND	(4)	58	.	53	16.0	34
Oklee	(4)	55	.	54	16.5	34
Knudson	(4)	60	.	53	15.3	33
Oxen	(4)	62	.	51	13.7	33
Russ	(4)	59	.	53	14.8	37
Reeder	(5)	61	.	53	15.4	36
Norpro	(5)	61	.	51	15.0	31
Chris.CK	(5)	47	.	52	16.7	40
Dandy	(7)	57	.	54	14.6	39
Alsen	(6)	54	.	53	14.6	33
Mercury	(7)	62	.	54	15.6	30
Granite	(7)	53	.	54	17.9	34
Polaris	(9)	53	.	52	16.7	35
SD 3618	(-)	57	.	52	16.7	35
SD 3623	(-)	52	.	54	13.6	40
SD 3635	(-)	54	.	52	15.2	38
SD 3668	(-)	53	.	52	16.5	38
SD 3687	(-)	60	.	53	14.4	36
SD 3746	(-)	59	.	51	14.9	32
SD 3747	(-)	66	.	51	13.8	33
SD 3827	(-)	59	.	53	14.4	38
SD 3860	(-)	56	.	52	14.5	40
SD 3868	(-)	64	.	52	11.8	36
BZ998-447WP	(-)	52	.	49	15.5	33
MN 97803A	(-)	56	.	54	16.9	33
Test avg.:		57	.	53	15.2	35
High avg.:		66	.	55	17.9	40
Lsd(.05):		5	.	1	.	3
# TPG-value:		61	.	54	.	37
C.V.:		6	.	2	.	

* Heading relative difference in days compared to Briggs.
# Minimum value required for the top performance group.

Table 2. Oat performance results- Nelson Brothers, Miller, S.D., 2003-2004.

Variety	(Hdg)*	Bu/a 2004	Bu/a 3-yr	Bu wt lb	Prot %	Ht in
Standard types:						
Don	(1)	114	.	38	15.2	32
Reeves	(2)	105	.	40	15.6	39
Hytest	(4)	107	.	41	17.2	40
Jerry	(5)	120	.	39	15.5	38
Morton	(7)	126	.	38	15.0	41
Loyal	(8)	115	.	38	14.4	40
HiFi	(8)	130	.	37	14.7	38
Hulless types:						
Buff Hls	(3)	102	.	43	15.7	34
Stark Hls	(6)	100	.	37	15.7	40
Paul Hls	(7)	86	.	39	17.2	42
Experimentals:						
SD 366	(-)	132	.	39	14.9	36
SD 366-7	(-)	129	.	41	14.5	39
SD010062	(-)	119	.	41	16.1	41
SD011226	(-)	131	.	39	15.4	38
SD011315	(-)	131	.	37	12.0	38
SD 366-15	(-)	132	.	40	16.5	39
SD 366-23	(-)	125	.	40	15.7	39
SD 366-36	(-)	133	.	41	15.2	37
Test avg.:		119	.	39	15.4	38
High avg.:		133	.	43	17.2	41
Lsd(.05):		14	.	2	.	2
# TPG-value:		119	.	41	.	31
C.V.:		8	.	4	.	6

* Heading, relative difference in days compared to Don.
# Minimum value required for the top performance group.

Barley: As indicated in Table 3, the average yield for 2004 was 87 bu/a and varieties had to yield 97 bu/a to be in the top performance group for yield. The top performance group for yield in 2004 included the varieties Haxby, Excel, and Eslick.

In 2004, the average bushel weight was 49 lb, the average grain protein was 11.0%, and the average plant height was 35 inches. In 2004, all the entries tested were in the top performance group for bushel weight because the trial was unable to detect any variety difference in bushel weight. The varieties Conlon, Tradition, Drummond, Robust, Eslick, and Valier and the experimental ND16301 were above average in grain protein. In 2004, entries had to attain a height of 37 inches or more to be in the top performance group for maximum plant height. This group included the varieties Tradition, Excel, Robust, and Legacy and the experimental line ND16301. In contrast, entries had to attain a height of 33 inches or less to be in the top performance group for minimum plant height. This group included the varieties Conlon, Haxby, and Eslick.

Table 3. Barley performance results- Nelson Brothers, Miller, S.D., 2003-2004.

Variety	(Hdg)*	Bu/a 2004	Bu/a 3-yr	Bu wt lb	Prot %	Ht in
Lacey	(1)	85		49	11.2	35
Conlon	(1)	80		49	11.5	33
Tradition	(1)	84		49	11.5	37
Drummond	(3)	85		48	11.4	36
Haxby	(3)	95		50	10.5	33
Excel	(4)	90		48	10.3	37
Robust	(4)	76		49	11.3	39
Eslick	(4)	97		49	11.2	31
Legacy	(4)	89		48	9.9	37
Valier	(5)	89		50	11.5	34
ND16301	(-)	84		47	11.2	37
ND 19-119	(-)	85		49	10.3	34
Test avg.:		87		49	11.0	35
High avg.:		97		50	11.5	39
Lsd(.05):		7		NS		2
# TPG-value:		90		47		37
C.V.:		6		3		4

* Heading, relative difference in days compared to Lacey
# Minimum value required for the top performance group.

Table 1. Yield results of entries in the 2004 Crop Performance Testing (CPT) nursery.

	Grain Yield (bu/a)										TW (lb/bu)
Entry	Average	Brookings	D. Lakes Pea	Highmore	Platte	Selby	Sturgis	Wall	Watertown	Winner	Average
SD97538	65	103	55	78	63	77	29	53	47	58	59
SD92107-5	63	96	52	78	76	71	27	61	42	49	59
SD00W024	63	99	53	71	71	70	28	59	44	53	59
SD97059-2	62	98	51	82	62	72	24	52	52	52	58
SD97394-1	62	99	58	77	62	75	29	47	46	51	59
SD98102	62	92	54	78	69	73	30	49	53	49	59
WAHOO	62	100	53	78	63	70	26	57	37	52	58
HARDING	61	93	46	76	72	68	27	56	45	52	58
JERRY	61	106	46	79	62	71	29	53	45	40	58
SD00258	61	103	47	73	66	70	24	50	47	52	58
MILLENNIUM	60	100	47	74	60	70	29	47	46	55	59
SD99073	60	91	57	76	61	66	24	49	46	51	59
JAGALENE	59	82	58	73	55	72	24	52	39	60	60
NE99533-4	59	90	55	73	60	67	29	50	44	50	60
SD97250	59	88	54	74	63	64	27	46	56	49	59
ALLIANCE	59	83	53	75	64	71	29	46	50	51	59
SD00111	58	84	55	76	59	71	24	46	46	48	59
SD97380-2	58	90	51	77	59	67	24	45	48	47	59
SD00032	57	90	53	71	57	68	19	46	53	49	59
TANDEM	57	84	53	71	63	65	26	51	42	46	60
SD97W671-1	57	88	55	76	53	67	21	47	41	46	59
WESLEY	56	96	47	72	60	58	25	48	42	39	58
SD97W609	56	86	50	67	58	69	22	41	38	44	58
TREGO	55	82	49	68	59	63	27	36	49	57	61
NEKOTA	55	86	51	72	58	60	28	45	31	47	59
SD00W041	54	78	45	73	56	65	21	49	25	56	59
ARAPAHOE	54	79	45	74	57	71	21	40	34	47	58
CRIMSON	54	80	53	64	57	66	27	48	41	38	59
EXPEDITION	53	91	45	62	58	62	21	47	39	40	60
SD97W604	53	86	42	66	48	65	25	45	39	50	59
MEAN	59	91	51	74	61	68	26	49	44	49	59
LSD.05†	3.5	16.4	13.1	7.6	10.4	6.9	7.2	5.7	13.8	8.1	0.47
CV%‡	12.2	12.9	18.2	7.2	12.1	7.2	17.4	8.1	15.5	11.64	1.6

‡ The CV (coefficient of variability) is a statistical measure of experimental error. In general, yield trials with a CV of 16% or greater are considered to contain too much experimental error for reliable data interpretation.

† The LSD (least significant difference) is the minimum value by which two entries must differ in order for that difference to be meaningful (and not be due to random chance alone). If the difference between two entries is equal to or less than the LSD value, the entries are not statistically different.

Corn Breeding

Zeno W. Wicks, III and Dawn M. Gustafson
South Dakota State University

The SDSU corn breeding and genetics program primary foci are to conduct applied research in corn breeding and to train graduate students. Specific objectives that we would like to achieve:

1. Develop and release inbred lines and improved populations that can be used to develop hybrids for livestock feed, grain production, or other value added products. Emphasis will be placed on yield, adaptation, stress tolerance, and pest resistance.
2. Evaluate and select corn adapted to South Dakota for phosphorous and nitrogen content to be used as a complement/supplement to DGs/co-product feed.
3. Develop open-pollinated corn varieties, populations, and synthetics for sustainable agricultural operations (i.e. organic farmers) and conventional farming.
4. Continue to develop white corn as an alternative crop.

Activities

The Corn Breeding and Genetics Program utilizes the Highmore Research Station to conduct droughty, high-stress environmental evaluations. Typically, we conduct high-stress yield trials and select for drought/heat tolerance in our early-generation materials.

The corn breeding studies/trials conducted at the Highmore Research Station during the 2004 growing season included:

1. The Northern Central Region (NCR-167) corn performance nursery consisting of 29 advanced inbred testcrosses from Wisconsin, Iowa, North Dakota, Ontario, and Ottawa. These lines are in final stages of testing to determine the relative merit of release to interested breeders.
2. A stress maize population hybrid trial. The objective of this trial is to help determine the relative merit of improved populations for release. The goal is to identify the higher yielding populations growing under stressful conditions. These would serve as an improved germplasm source for development of inbred parents for early maturing, high quality, and high yielding corn hybrids; and as elite parents for early maturing maize population hybrids that can be used as an alternative to commercial hybrids.

Outcomes

The nursery conditions at the Highmore Research Station were extreme. The severity of the stress resulted in the abandonment of the trials. However, we will continue to conduct drought/heat tolerant yield trials and utilize the Highmore Research Station for heat stress selection pressure in the future.

Acknowledgements

This research was sponsored by the South Dakota Corn Utilization Council. We also appreciate the financial support provided by the SDSU Agricultural Experiment Station and the SDSU Plant Science Department.

We would also like to thank Mike Volek, agricultural research technician for the Highmore Research Station, for establishing and maintaining the corn nursery and for his readiness to aid our project.

Evaluation of Native and Naturalized Grasses for Reduced-Input Turf in the Northern Plains

L.C. Schleicher and **S. M. Andersen**
South Dakota State University

Commercially available cool-season turfgrasses typically perform better in cool humid regions compared to the cool arid region common to most of South Dakota. Management response to temperature extremes, infrequent precipitation, and poor soils generally results in increased inputs of water, fertilizer, pesticides, and culture.

Previous SDSU research has demonstrated the need for turfgrasses with improved environmental stress resistance. Native and naturalized grasses tend to thrive in their areas of adaptation, generally requiring less water, fertilizer, and pesticides. Use of turfgrasses that are better adapted to the Northern Plains may improve turfgrass quality while reducing turfgrass inputs.

The richness of genetic resources among the largely untapped grasslands of the western U.S. represents tremendous potential for turfgrasses. The need to expand existing germplasm collections of native and naturalized grasses is widely recognized, and development of these grasses may provide an economic stimulus to the region.

Objectives

The objectives of this research are to

1. collect and preserve grass samples obtained from native grasslands and other high potential sites in the Northern Plains,
2. establish replicated plots to evaluate turfgrass characteristics, response to environmental stress, and sustainability as a reduced-input turfgrass,
3. investigate environmental stress resistance mechanisms that are important to Northern Plains adaptation, and
4. work collaboratively with interdisciplinary and multistate scientists to enhance the value of the project.

The Agricultural Experiment Station at Highmore was selected for the initial grass evaluation because of temperature extremes, infrequent and low annual precipitation, soils typical of much of South Dakota, and relative proximity to Brookings. Selections exhibiting desirable characteristics at the Highmore station will be established later at the N.E. Hansen Research Center in Brookings for further evaluation.

Methodology

Grass samples exhibiting desirable turfgrass characteristics were collected from multiple sites across South Dakota and sent to the SDSU campus in Brookings to be vegetatively propagated in the Turfgrass Science lab and horticulture greenhouses. Propagules were transported to the Highmore station and planted in 1.5 m x 1.5 m field plots with three replicates in a randomized complete block design. Plots received minimal input; i.e., infrequent mowing, irrigation only at establishment or to prevent death, and no fertilization. A preemergence herbicide will be used annually to reduce hand-pulling of weeds. Grasses will be evaluated over a 3-year period for survival, horizontal growth rate, persistence, turfgrass density, response to mowing, genetic color, drought resistance, and disease susceptibility.

Progress to Date

Species collected in 2004 include blue grama (*Bouteloua gracilis*), buffalograss (*Buchloe dactyloides*), inland saltgrass (*Distichlis spicata*), Kentucky bluegrass (*Poa pratensis*), and Sandberg bluegrass (*Poa secunda*).

Approximately one-half of the individuals collected during summer 2004 were propagated and planted at Highmore in 2004. The remainder will be planted in spring 2005. Additional plants will be collected in 2005 and 2006. Locations of plants collected in 2004 are illustrated in Fig 1.

Acknowledgement

The authors would like to thank Mike Volek, Robin Bortnem, and the following undergraduate research assistants for their contribution to this project in 2004: Heather

Achtenberg, Elizabeth Albrecht, David Haroiach, Nick McGinnis, Joe Schaefer, and Rebecca Wek. This project is partially funded and supported by the SDSU Agricultural Experiment Station and the South Dakota Turf Foundation.

Fig 1. Locations of grasses collected in South Dakota in 2004.